

Terrain Simulation



Below is a view of Planet Earth from orbit. It is a frame from the 42-minute Imax film *Blue Planet*, which has been seen by more than eight million people at giant screen Imax theatres. Produced by Imax Space Technology, Inc., a subsidiary of Trax Corporation, Toronto, Ontario, *Blue Planet* is presented by the Smithsonian Institution's National Air and Space Museum and Lockheed Corporation in cooperation with NASA.

Much of *Blue Planet* features breathtaking views of Earth filmed in orbit on five Space Shuttle flights by astronauts trained to operate the IMAX® cameras, which produce an image three times larger than standard 70-millimeter motion picture film. The film, says Imax, "gives audiences worldwide a view of their global home that is as close to being in orbit as one can possibly get."

Blue Planet, however, is more than an orbital travelogue; it is a film with a message, a depiction of the powerful forces that affect Earth from within and without, and the effects of natural and man-made influences

on the delicate balance among those forces.

A highlight of the film is a 100-second computer-generated animation of a flight and earthquake simulation along California's San Andreas Fault. This sequence, created by the Visualization and Earth Sciences Application (VESA) Group of Jet Propulsion Laboratory (JPL), employed new three-dimensional perspective rendering (3DPR) techniques, a technology in development at JPL since 1985. The *Blue Planet* sequence marked a milestone in transferring 3DPR technology to the private sector; it had been employed in earlier films, but never on the scale demanded by the San Andreas simulation.

The accompanying images are sample frames from the computer-animated sequence, developed from data sent from orbit by the Landsat Earth resources monitoring satellites. At **top right** is a view of California looking northwest over the Salton Sea with San Diego at far left and a portion of the Colorado River at far right. The **lower right** photo is centered on San Francisco with Mt. Shasta on the horizon at left photo and the Sierra Nevada Range at center and right.

The 3DPR work at JPL is part of a broader program of scientific visualization, a field devoted to exploring new ways of presenting voluminous data to scientists, allowing experts in various fields to understand large volumes of data quickly and easily.

One such technique is terrain rendering, a type of scientific visualization employed by scientists as an effective means of recognizing patterns in remotely sensed data. Terrain rendering involves superimposing image data on digital elevation maps to produce a three-dimensional simulation of the actual terrain. When image and eleva-





create 2,160 frames, which were sent on tapes to Imax and there transferred to film. Development and use of an

tion data are thus combined, the topography and imagery become much clearer and may suggest further information, for example, what is *beneath* the surface.

The *Blue Planet* task required development of new technology to make possible terrain rendering of very large digital images within the short period allowed by the film company's schedule. The data that made the animation possible was an image mosaic of California constructed from Landsat Multispectral Scanner scenes, combined with more detailed Landsat Thematic Mapper data for the San Francisco area. Elevation data for terrain mapping was obtained from the U.S. Geological Survey.

To create the San Andreas flight simulation, the VESA Group used 727 megabytes of image and elevation data to

advanced pyramidal terrain rendering technique reduced what would have taken close to a year of computer time by earlier methods to about 50 days.

In addition to the commercial spin-off, the new techniques have provided NASA an important payback. Large mosaics of Venus were assembled from the data supplied by the Magellan spacecraft. The visualization group at JPL and the Magellan science team were able to produce high-resolution terrain animations of Venus from these mosaics. JPL continues to develop new perspective rendering technologies as a means of coping with the vastly increased volume of remote sensor data expected in the coming decade. ●

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